CMST Capability Statement

Ship Hydrodynamics Modelling

Rottnest ferry in rough seas off Fremantle

CMST analyzed the roll behaviour of the research vessel "Solander" for the Australian Institute of Marine Science

Ship motions in waves

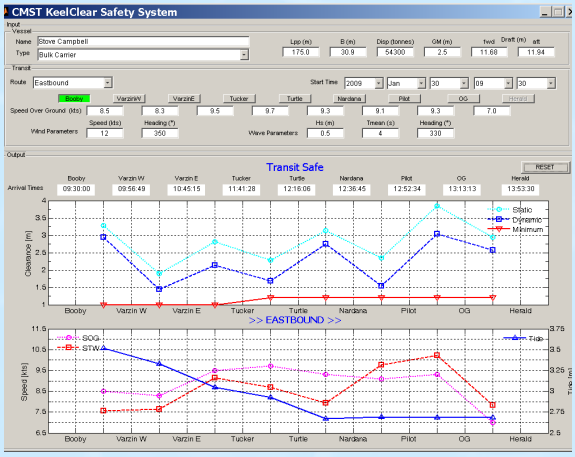
CMST is able to model wave-induced motions of most vessel types, using licensed and in-house software. We have prior experience in modelling the following vessel types:

- pilot boats and tugs
- research vessels
- offshore support vessels
- patrol boats and warships
- containerships, tankers and bulk carriers

Ship motions in 6 degrees of freedom can be predicted using SEAWAY, SEAKEEPER or WAMIT, combined with our own in-house analysis software. Ship motions modelling can be done for vessels in deep or shallow water; zero or forward speed; at sea or tethered at the berth. Applications include:

- Roll reduction and natural roll period optimization at the design stage
- Testing of vessels at the design stage against acceptable motions criteria
- Slamming and green water on deck analysis
- Predicting absolute motions at critical points, such as crane tips of offshore vessels
- Determining sea state limits for critical operations

CMST undertook an assessment of containership UKC guidelines for the Hong Kong Marine Department



KeelClear software developed by CMST in association with Australian Reef Pilots, and used by ships in Torres Strait from 2006 - 2010

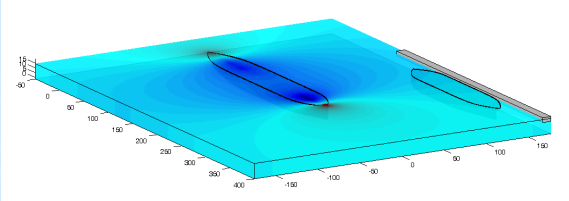
Under-keel clearance

CMST has developed a suite of in-house software entitled "ShallowFlow" for predicting the grounding risk of ships moving in shallow water. The hydrodynamic effects able to be modelled include:

- Ship squat, using PIANC standard methods, as well as more complex effects of variable channel shape and variable depth
- Wave-induced motions, using basic motions data from SEAWAY shallow-water ship motions software
- Heel due to wind and turning, using International Maritime Organization standard methods
- More complex effects, such as increased squat due to passing vessels and dynamic trim during turns

Applications include:

- Ship-specific squat tables, for the ship's bridge
- Channel-specific under-keel clearance tables, for harbourmasters and pilots
- Channel-specific under-keel clearance software, combining with real-time environmental inputs
- Long-term transit simulation studies for dredging depth optimization



Hydrodynamic pressure field caused by a capesize bulk carrier passing a panamax bulk carrier at the berth, calculated using ShallowFlow software. Similar methods were used to test the feasibility of installing a vacuum fendering system at Harriet Point berths, Port Hedland, for Maunsell AECOM.

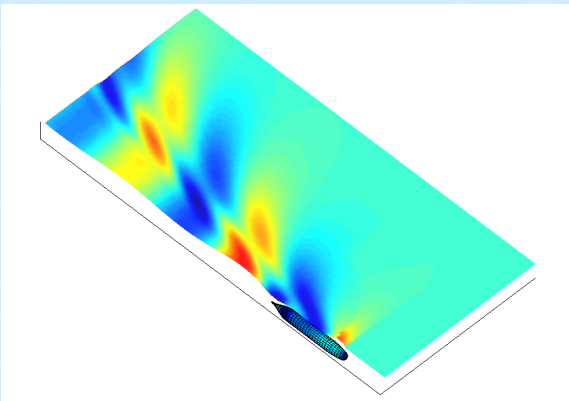
Forces on moored vessels

For ships at the berth, CMST is able to calculate the following effects on mooring loads:

- Wave-induced motions, including mooring line forces
- Harbour resonance and long-wave seiching
- Wind loads, using standard IMO methods
- Current loads, using empirical methods
- Passing vessel loads (principally surge, sway and yaw), using CMST's ShallowFlow software and experimental data

Applications include:

- Calculating design loads for mooring systems
- Diagnosing mooring line breakage issues



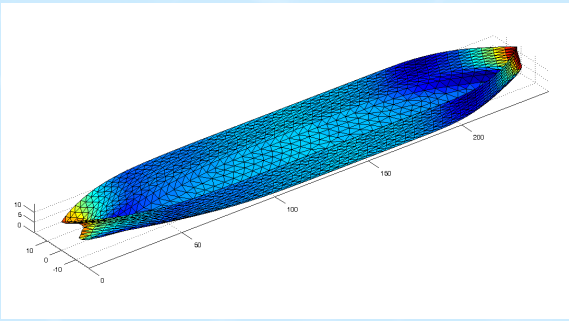
Wave pattern produced by a near-surface submarine, calculated using HullWave software. Collaborative research with DSTO and AMC in this area is helping to inform Australia's next-generation submarine design.

Resistance and wake

CMST has developed a Havelock-source panel code entitled "HullWave", which is capable of calculating wave resistance and wave patterns of near-surface submarines. The software is currently being extended to cater to ships and surface-piercing submarines. As well as this, CMST has access to various methods for modelling ship resistance through the Maxsurf software suite, as well as Michlet thin-ship software. A wide range of model test data is used for validation and empirical corrections of theoretical predictions.

Applications include:

- Calculating hull resistance at the design stage
- Optimizing hull shapes for low resistance
- Testing of vessel wakes against low-wash criteria at the design stage



Pressure coefficient on a standard series bulk carrier hull in deep water, using the double-body approximation. Calculated using HullWave software.

General flow calculations

CMST is able to model a wide range of hydrodynamic flow phenomena. As well as the in-house software described above, we also use

- OpenFOAM CFD software for viscous flow phenomena
- XFoil foil analysis software
- Empirical methods based on model testing and full-scale testing data

General flow analysis work that we do includes:

- Diagnosing cavitation damage caused by foils, brackets and propellers
- Diagnosing flow-induced vibration problems
- Modelling effects of hull retrofits on speed performance

Founded in 1985, the Centre for Marine Science and Technology comprises a multi-skilled body of scientists and engineers committed to research and development. It conducts world-class consulting, research, technology development and education for industry and government agencies.

Three modes of operation are available:

- Commercial-in-confidence consulting, research and development
- Accessing state and federal government grant schemes
- Postgraduate student research

A wide range of clients have utilised the ship hydrodynamics services of CMST including: AECOM, AIMS, Australian Reef Pilots, BAE Systems, DSTO, Fremantle Ports, Fugro-TSM, Hanseatic, JFA Consultants, Marine Department Hong Kong, NZ Maritime Safety Authority, Swan River Trust, Tidewater Marine.

p: +61 8 9266 7380 | e: info@cmst.curtin.edu.au | CMST, Curtin University, GPO Box U1987, Perth WA 6845, Australia | www.cmst.curtin.edu.au